For Eric - I wish this were up to your standard, but it was written somewhat hastily. Peter 5/26/89

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Mestrelle's Minting Methods - A Query

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Numismatists have for many years recognized the extraordinary qualities of the pieces known as the "milled money" of Elizabeth I. In 1841 Hawkins described them as "...similar to the hammered in type, but better executed, much neater in appearance, rounder in form,..."[1] He prefaced this by stating: "In 1561, a new process of coining was introduced by a Frenchman, by means of the mill and screw; the name of the Frenchman is unknown and the whole history of the process and its employment is involved in singular obscurity."[1] A century and a half later, the name Eloy Mestrelle is well-known,[2] but little else has changed: the milled money is recognized by its appearance, it is assumed to have been struck with a screw press, and Mestrelle's minting methods are still shrouded in obscurity. It is the purpose of this note to call for a serious attempt to establish whether the obverse and reverse designs were indeed applied to Elizabeth's milled money by means of a screw press, to suggest a possible alternative, and to propose means to resolve the question.

The long-held belief that Mestrelle employed a screw press is certainly the currently accepted view.[3] It may be of interest to explore the basis on which this view rests. In their detailed study of the milled coinage of Elizabeth I, Borden and Brown describe Mestrelle's techniques as follows: "The metal was cast into special ingots which were passed through a cutter that gave blanks about ten per cent overweight. The accuracy of this cutter was not great enough to produce blanks within the required tolerance and they were therefore laboriously passed through rollers several times and recut (annealing between times where necessary) until their weight was within the required limits.[4] The design was then impressed with a balancier or screw press."[5]

Borden and Brown credit Symonds[6] and Challis[7] for their descriptions of Mestrelle's apparatus. In his 1916 paper "The Mint of Queen Elizabeth and Those Who Worked There" Symonds did not claim knowledge about the kind of machine used by Mestrelle to impress the dies.

Symonds did quote an account prepared by the under-treasurer of the "upper houses" of the Tower mint which gave the charges for "certain presses, rollers and cutters of iron and steel and divers other engines". Symonds also quoted from the comptroller's book of expenditures sums spent on "The Presse": "crossbowe steele" and "For y^e forgeinge of the same into roolers,... For a peyre of cheekes for the same roulers,..." etc. Symonds suggested that this apparatus was "....not a coining press but a roller press for reducing the ingots of metal to the desired thickness, preparatory to the cutting-out of the blanks."

Symonds' identification of this description of Mestrelle's machinery as relating to a rolling mill was supported by a correspondence with W.J. Hocking of the Royal Mint. Hocking added that "It is noteworthy that no mention is made of a balancier, or any special contrivance for using the dies more effectively."[6]

In an earlier 1909 paper, Hocking stated: "So far as is known there is no specification extant of the tools introduced by Mestrell, but his improvements were probably confined to the cutting of the blanks perfectly round by means of a cutting-punch, and striking them with dies in some form of press or balancier."[8] Hocking went on to describe the confusion of the terms 'mill' and 'screw', pointing out that 'mill' properly referred to a rolling mill used to reduce ingots to strip, while 'screw' referred to a coining press. Hocking pointed out additional confusion due to the circumstance that the first French use of machinery for coinage was in the 'Monnaie du Moulin', so called because of the water mill used to propel the machinery. Hocking believed that this 'mill mint' employed a screw press for striking the blanks with dies, thus associating the terms 'mill' and 'screw'.

Challis, in his monograph The Tudor Coinage, gives sound reasons for his belief that Mestrelle employed a screw press.[7] He quotes from contemporary records, the Salisbury Manuscripts, descriptions of its components as including 'a worm [cast from 50 lb of copper] and a vice to the press', 'a bar of iron to the press', 'a box of steel for the vice', and 'tongs with stamps onto them'. These do indeed sound like the components of a screw press that could be used for coinage, but these components may belong to the cutting press that gave the milled coinage its characteristic roundness. If the 'worm' was the threaded shaft on whose lower end the upper die was mounted, copper may be too soft a material for this critical component of a coining press. Cellini writing at nearly the same time recommended iron for the main screw.[9] A rolling mill was also called a press, and rolling mills need adjusting devices in the form of screws to maintain the proper distance between the rollers.

Many other students have written on this question without breaking new ground. In his magisterial history of the Royal Mint, Sir John Craig says of Mestrelle: "He appears to have brought in machines of the screw type, worked by horse and by water power, for cutting blanks and for stamping coins, ..."[10]

Goldman's paper "Eloye Mestrelle and the Introduction of the Mill and Screw Press" states the premise implied by the title without argument beyond the 1562 description of the milled money by Grindal, Bishop of London, as being "stamped after a new fashion, and in a manner resembling print."[11] This vivid passage, which does indeed suggest a screw press if it refers to the mechanical device employed rather than the appearance of the lettering, had already been noted by Hocking.[8]

Cooper, in his recent history of minting technology, limits his argument to: "Mestrell produced coins which were much more neatly finished than hand-struck pieces, implying that he was using a screw press and striking coins between dies in a collar. ....they look as if they could have been struck in this way.[12]

This brings us to the coins themselves, and despite reservations about the use of a collar, one must agree in part with Cooper. They do have the appearance of having been struck within a collar, in that they lack the bifurcated letter bases and fugitive beading associated with radial flow of metal unconstrained by a collar during the striking process.[13] That Mestrelle employed a collar is rendered unlikely by observations published by Hocking in 1909.[8] He noticed a burr on the edges of some of the milled coinage at right angles to the faces of the coins, sometimes on the obverse side, sometimes on the reverse, but never on both. He associated this burr with the cutting out of the blanks with a circular cutting punch. If this operation had been carried out prior to blows of the dies on the blanks held within a collar, the burrs would have been turned parallel to the faces of the finished coin, or eradicated by being squeezed against the collar.

The use of a collar is also rendered unlikely by the observations of Sir Charles Oman, who wrote in 1931: "It is curious to find that there is not perfect and unvarying relation between obverse and reverse types, so that the dies must have been fixed into the press in somewhat haphazard fashion. But the coins are invariably well 'struck up', every letter showing distinctly-a thing very rare with hammered coins."[14] Oman does not comment on the nature of the press employed by Mestrelle to strike the coins, except to indicate that he brought the 'mill-method' from Paris.

If Mestrelle's 'milled money' was struck without a collar, yet the coins do not display the signs of radial metal flow associated with the use of a screw press without a collar, what can be suggested to explain their appearance?

If a screw press was employed, then the outward flow of metal was somehow suppressed. This could have been due to cutting out the finished coins with a hollow punch after striking, the metal of the strip on which the dies were impressed acting like a collar to prevent radial flow.

Oman's observation that the obverse and reverse dies were often poorly registered,[14] and the finding by Borden and Brown that obverse and reverse dies were frequently changed together,[5] suggest that another explanation should be considered. There are mechanical coining devices in which interchangeability of dies and registry of the obverse and reverse dies present difficult mechanical problems. These are the roller press and the rocking press, widely known by their German names, 'Walzenwerk' and 'Taschenwerk' respectively.[15] These have both been shown to have received limited use by Briot in the 17th century by the recent work of Besly[16] and Sellwood.[17]

In the 'Walzenwerk' process, the obverse and reverse designs were engraved on rollers mounted in a press that acted like a rolling mill. The designs were impressed on strips of metal that were passed between these rollers, but perfect registry of the obverse and reverse was difficult. In a final operation the coins were punched from the strip in a screw press, and if there was a registry problem, one side of the coin or the other would appear to have been struck off-center.

Each roller in a 'Walzenwerk' press usually carried several obverse or reverse designs.[18] There is thus the possibility of as many distinguishable obverse and reverse die combinations as the the number of designs on the obverse roller times the number of designs on the reverse roller. The small number of die links observed by Borden and Brown[5] is thus hard to reconcile with the 'Walzenwerk' process, unless the gearing of the engraved rollers was such as to prevent a change in registry of one roller relative to the other.

In a 'Taschenwerk' or rocker press, individual dies with curved faces,[19] mounted on axles, acted as segments of the engraved cylinders of the 'Walzenwerk' press. This decreased the cost of replacing damaged dies in the 'Taschenwerk' compared to the 'Walzenwerk' coining press, since in the latter process a roller might already need replacement when one of the designs it carried was damaged, but the others were still good. Some rocker presses used only a single pair of dies and would thus give rise to the dearth of die links noted in the Elizabethan milled coinage. It should be noted however that rocker presses were often fed cut blanks rather than strip. This is not in accord with the burrs noted on the edges of the 'milled money', and the telltale marks of a rocker press striking cut blanks, noted by Besly[16], have not been noticed on this series.

From what has been stated above it is difficult to avoid concluding that there is a discrepancy between the long-standing tradition that Mestrelle employed a screw press, and the appearance of the coins themselves. The seven plates illustrating Borden and Brown's paper on the milled coinage of Elizabeth I[5] show few if any coins that display the characteristic signs of radial metal flow associated with the use of a screw press without a collar.[13]

It is the purpose of this note to call for a renewed examination of the coins to elucidate the means used to manufacture them. Are there telltale signs of a roller or rocker press such as the pinching and slightly oval shapes associated with the latter process? The tendency for numismatists to see only what they expect to see suggests that a fresh look at the coins is necessary. In addition to simple visual examination and optical microscopy, nondestructive physical methods such as acoustic microscopy and x-ray diffraction should be used to determine whether differential orientation of the metallic grains has occurred.[20] This would be expected if a roller or rocker press was employed, since the squeeze given by these techniques leads to unidirectional metal flow, rather than the radial flow of metal imparted by a blow of a screw press, unimpeded by a collar.

In addition to a fresh examination of Elizabeth's milled coins and a search for further historical evidence, the 'Monnaie du Moulin' also deserves attention. Did Mestrelle bring his methods from Paris, as is widely assumed? It would be useful to determine what connection there was between Mestrelle and the Paris mints, and to establish what kind of machinery was used there in the 1550's. Mazerolle's 1907 history of the Paris mint states that the coining press obtained from the mysterious 'chevalier du Saint-Sépulcre', believed to be the goldsmith Max Schwab of Augsburg, was a balancier or screw press.[21]

The recent study by Moser and Tursky of the mint of Hall in the Tirol, where roller presses were in use from 1571 to 1747, suggests instead that Schwab's machine was a roller press.[22] It is interesting to note however that the three French milled coins of the 1552-53 period illustrated by Hocking,[8] display the bifurcated letter bases associated with the screw press used without a collar, while the 1573 piedfort with straight letter bases was struck with a segmented collar, also consistent with a screw press.

In closing, it has been my purpose not to challenge the received wisdom concerning Mestrelle's techniques, but to point out that the time is ripe to eliminate the remaining uncertainties by taking a fresh look at the coins as well as the historical evidence. Mestrelle's techniques occupy a position of considerable importance in the evolution of coinage in Britain, and the means are at hand to answer the questions posed above. As our inspiration, we should take the work of Besly[16] and Sellwood[17] who have so ably clarified the mechanical techniques of Briot.

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Footnotes and References

1. E. Hawkins, "The Silver Coins of England", Edward Lumley, London, 1841, p.152. In the preceding century Folkes had already written of "...pieces coined in a more elegant taste, and as it seems by the mill and screw." in "Tables of English Silver and Gold Coins First Published by Martin Folkes, Esq.", Society of Antiquaries, London, 1763, p. 54.
2. It is well-known that confusion with another Mestrelle also has a long history. Pinkerton wrote, quoting Stow's Annals, that: "Phillip Mestrell, a Frenchman, brought the mill over here,..." in "An Essay on Medals", James Dodsley, London, 1784, p. 206, footnote.
3. The list of citations is too long for this note, but includes Ruding, Henfrey, Brooke, Seaby, W.A.C. Newman, and Stride, among many others.
4. This description is puzzling in its implication that banks were cut from ingots before being passed through a rolling mill. The punching of blanks from other banks, that is to say from pieces of metal just larger than the desired product, is difficult. More likely is the process described by Symonds, *vide infra*.
5. D.G. Borden and I.D. Brown, *BNJ*, *1983*, *53*, 108-132.
6. H. Symonds, *NC*, *1914*, 4th ser., *XVI*, 61-105, esp. 69-76.
7. C.E. Challis, "The Tudor Coinage", Manchester University Press, Manchester, 1978, pp. 16-19.
8. W.J. Hocking, "Simon's Dies in the Royal Mint Museum, with Some Notes on the Early History of Coinage by Machinery", reprinted from *NC*, 4th series, *IX*, with preface added, London, 1909.
9. "The Treatises of Benvenuto Cellini on Goldsmithing and Sculpture", translated by C.R. Ashbee, Dover, New York, 1967, pp. 77-78.
10. Sir John Craig, "The Mint", Cambridge University Press, Cambridge, 1953, p. 123.
11. P.H.J. Goldman, *The Numismatic Circular*, *1974*, *LXXXII*, 422-427.
12. D.R. Cooper, "The Art and Craft of Coinmaking, A History of Minting Technology", Spink & Son, London, 1988, p. 54.
13. G.P. Dyer and P.P. Gaspar, *BNJ*, *1980*, *L*, 117-127.
14. C. Oman, "The Coinage of England", Clarendon Press, Oxford, 1931, p. 280.
15. P.P. Gaspar, "Coining and Die-Making Techniques in the 17th Century", *Metallurgy in Numismatics*, submitted for publication.
16. E. Besly, *BNJ*, *1984*, *54*, 210-241.
17. D. Sellwood, *BNJ*, *1986*, *56*, 108-123.
18. For excellent illustrations of cylindrical dies for the 'Walzenwerk' press, see E. Fiala, "Katalog der Münzen- und Medaillen-Stempel Sammlung der K.K. Hauptmünzamtes in Wien", K.K. Hofs- und Staatsdruckerei, Vienna, vol. I, plate III.
19. Rocker press dies are illustrated on plate IV of reference 18.
20. M.F. Striegel, "Residual Stresses in Numismatics", doctoral dissertation, Washington University, St. Louis, 1989.
21. F. Mazerolle, "L'Hôtel des Monnaies", Librairie Renouard, Paris, 1907, p.27.
22. H. Moser and H. Tursky, "Die Münzstätte Hall in Tirol 1477-1665", Dr. Rudolf Erhard, Innsbruck, 1977, p.111. Moser and Tursky also mention, p.112, that an Augsburg mintmaster, Kaspar Seller, attempted to establish mechanical minting methods in London in the 1550's, without success, at nearly the same time as Mestrelle. A "great mill" in the Tower erected by a "Mr. Brocke" in the reign of Mary is mentioned by H. Symonds, BNJ, 1911, VIII, 179-201, at p.191.